

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
2 October 2003 (02.10.2003)

PCT

(10) International Publication Number
WO 03/080275 A3

(51) International Patent Classification⁷: **B22F 9/14**,
C01B 21/076, C23C 4/10

(21) International Application Number: PCT/GB03/01250

(22) International Filing Date: 24 March 2003 (24.03.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0206906.0 23 March 2002 (23.03.2002) GB
0216712.0 17 July 2002 (17.07.2002) GB

(71) Applicant (for all designated States except US): **METAL
NONPOWDERS LIMITED** [GB/GB]; 39/40 Calthorpe
Road, Edgbaston, Birmingham B15 1TS (GB).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **CHANG, Isaac, Tsz,
Hong** [GB/GB]; 65 Foxes Meadow, Cotteridge, Birming-
ham B30 1BQ (GB).

(74) Agents: **WARD, David, Ian et al.**; Marks & Clerk, Alpha
Tower, Suffolk Street Queensway, Birmingham B1 1TT
(GB).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD,
SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US,
UZ, VC, VN, YU, ZA, ZM, ZW.

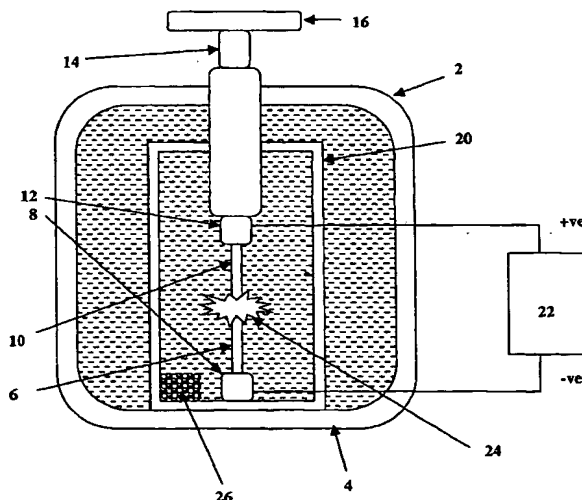
(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted
a patent (Rule 4.17(ii)) for the following designations AE,
AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH,
CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG,
KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK,

[Continued on next page]

(54) Title: **POWDER AND COATING FORMATION METHOD AND APPARATUS**



(57) Abstract: The invention relates to a process for the production of submicron particles (26) and comprises the steps of: (i) placing first and second electrodes, (6, 10) in a volume of coolant, such that the electrodes (6, 10) are mutually spaced, (ii) passing an electrical current across the electrodes to generate an electrical arc (24) between them, (iii) maintaining a stable arc (24) by controlling the relative spacing between the two electrodes (6, 10) to melt or evaporate and separate material from at least one of the electrodes (6, 10) such that droplets of said material are formed, and (iv) quenching said droplets to form said submicron particles (26) of the material in the coolant. The invention also relates to a powder coating method and to an apparatus for performing the methods of the invention.

WO 03/080275 A3



MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO

patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

Published:

— with international search report

(88) Date of publication of the international search report:

18 December 2003

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

In national Application No
GB 03/01250

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B22F9/14 C01B21/076 C23C4/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B22F C01B C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 879 518 A (KUEHNLE MANFRED R) 9 March 1999 (1999-03-09)	1-4, 10-17, 24,25, 28-33,35
Y	column 2, line 60 - column 4, line 33; figures	5-7,26, 27
X	US 4 731 515 A (SAVAGE STEVEN J ET AL) 15 March 1988 (1988-03-15)	1-4, 8-18,24, 25,28, 31-35
	column 1, line 38 - column 3, line 24; figure 2	
	----- -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

16 July 2003

Date of mailing of the international search report

30.09.03

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Alvazzi Delfrate, M.

INTERNATIONAL SEARCH REPORT

Int. Application No
IB 03/01250

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 294 242 A (SWAN ROBERT B ET AL) 15 March 1994 (1994-03-15) column 5, line 24 - column 7, line 14; figures	1-18, 24-28, 34,35
X	FR 2 727 635 A (REY PIERRE) 7 June 1996 (1996-06-07) page 4, line 8 - page 6, line 22; figures	1-4, 10-17, 24,25, 31-33,35
Y	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 06, 31 July 1995 (1995-07-31) & JP 07 070615 A (SANYO SPECIAL STEEL CO LTD), 14 March 1995 (1995-03-14) abstract	5-7,26, 27

INTERNATIONAL SEARCH REPORT

national application No.
PCT/GB 03/01250

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-18, 24-35

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-18, 24-35

Process and apparatus for producing powder by electric arc discharge wherein the spacing between the electrodes can be controlled to maintain a stable arc

2. claims: 19-23

Process for depositing a coating by electric arc discharge wherein the coating is at least partly derived from the coolant

INTERNATIONAL SEARCH REPORT

Int
nal Application No
IB 03/01250

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5879518	A	09-03-1999	NONE
US 4731515	A	15-03-1988	NONE
US 5294242	A	15-03-1994	NONE
FR 2727635	A	07-06-1996	FR 2727635 A1 07-06-1996
		AU 4307096 A 19-06-1996	
		WO 9616731 A1 06-06-1996	
JP 07070615	A	14-03-1995	JP 2779121 B2 23-07-1998